

Infrastructure Bottlenecks, Private Provision, and Industrial Productivity

A Study of Indonesian and Thai Cities

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Indonesia and Thailand have moved toward harnessing private help in mitigating deficiencies in publicly provided infrastructure services. Nigeria, still dominated by government monopoly, has been slow in encouraging private participation in infrastructure development.



Summary findings

This research project followed an earlier similar project on Nigeria, applying the same methods. A sample of manufacturers was surveyed to document their responses to infrastructure deficiencies in electricity, water, transport, telecommunications, and waste disposal.

They found that manufacturers undertook significant expenditures to offset deficiencies in publicly provided infrastructure services, and that changing public policy toward privately supplied infrastructure and changing the pricing of public infrastructure could yield significant savings in social costs.

Thailand and Indonesia have made significant strides in following the policies for private sector participation in infrastructure provision. Nigeria, where public infrastructure monopolies still dominate, lags behind, yet stands to benefit most from such policy reform.

Government policy toward the industrial organization and pricing of infrastructure sectors can significantly help a developing economy realize the benefits of private sector participation in the provision of infrastructure services.

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Prepared as part of the World Bank Research Project on Infrastructure and Productivity (RPO 676-71).

PREFACE

This report is a project summary of the research project, "Infrastructure Bottlenecks, Private Provisions, and Industrial Productivity: A Study of Indonesian and Thai Cities," which was jointly funded by the World Bank Research Committee (RPO 676-71) and USAID, Jakarta. Under the overall direction of Kyu Sik Lee, the study was jointly conducted with a research team headed by Chalongphob Sussangkarn at Thailand Development Research Institute, Bangkok, and a team headed by B.S. Kusbiantoro at Institute of Technology Bandung.

The following persons made contributions during the data collection phase of the project: Helen Garcia and Nachrowi of the World Bank; Suwandhi Sastrotaruno, and Sukmadi Bolo of the Indonesian Central Bureau of Statistics; Robert Rerimassie, Wawan and Dien Sanjoto of Hasfarm Consultants in Jakarta; Yongyuth Chalamwong, Suriya Wattanalee, Thaneit Khantigaroon, Dusit Jesdapipat of TDRI. The data work on Indonesia and Thailand was conducted by Gi-Taik Oh of the World Bank and the earlier work on Nigeria by Haeduck Lee of the World Bank.

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PROJECT SUMMARY

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**INFRASTRUCTURE BOTTLENECKS, PRIVATE PROVISIONS,
INDUSTRIAL PRODUCTIVITY:
A STUDY OF INDONESIAN AND THAI CITIES**

PROJECT SUMMARY

INTRODUCTION

The research project summarized here was jointly funded by the World Bank Research Committee (RPO 676-71) and by USAID, Jakarta. This project followed an earlier similar project on Nigeria ("A Study of the Impacts of Infrastructural Deficiencies on the Nigerian Industrial Sector and Their Policy Implications"), which was conducted as part of the World Bank research program on urban infrastructure and productivity.

The two projects applied the same methods and conceptual frameworks in each of the three countries. A sample of manufacturers was surveyed in order to document their qualitative and quantitative responses to infrastructure deficiencies in electricity, water, transport, telecommunications and waste disposal. These responses were subjected to descriptive and econometric analyses based on microeconomic models of the firm. The results showed that manufacturers undertook significant expenditures to offset deficiencies in publicly provided infrastructure services but also, that public policy towards privately supplied infrastructure and the pricing of such infrastructure can be adjusted from its current forms to yield significant savings in social cost. While Thailand and Indonesia have already made significant strides in the direction of our recommended policies, Nigeria does lag behind and stands to benefit most from such policy reform.

This summary is divided into seven sections. The contribution of infrastructure to productivity is discussed first making clear the complementary and changing roles of the private

and public sectors in infrastructure provision. Next, we sketch the public policy framework which emphasizes a microeconomic approach to studying the role of infrastructure in an economy. The project's rationale and its goals and methods are outlined, and empirical findings are discussed. Lastly, policy recommendations are presented with respect to industrial organization and with respect to the pricing of publicly supplied infrastructure.

INFRASTRUCTURE AND PRODUCTIVITY

A central question in economic development is the extent to which infrastructure investment positively influences the economic growth and productivity of nations. Infrastructure investment is a complex and multifaceted aspect of the national economies. Because it is difficult to study such a multifaceted problem in its entirety, studies of the relationship between infrastructure and economic growth and productivity have been limited to specific aspects.

Such partial views have led to a number of widely held biases about infrastructure investment. The most important of these biases is the treatment of infrastructure investment as being exclusively in the public domain. This has led to the view that a study of public investment is essentially a study of infrastructure investment. This view ignores several important characteristics of infrastructure.

First, there is an accelerating trend worldwide whereby publicly provided infrastructure investments and infrastructure facilities are becoming privatized. Privatization affects the ownership as well as the management of these infrastructure systems. Privatization implies that future increments of infrastructure investment will be increasingly undertaken by the private sector or by public-private partnerships.

Second, there has been a continuing trend in the industrialized countries, to deregulate and break up the large public or private monopolies. This has become feasible as well as desirable as technological progress has gradually eroded the economies of scale inherent in some natural monopolies. A good example of this is the telephone industry in the United States.

Third, rapid economic growth in many developing nations has forced the private sectors in these economies to undertake significant investments in infrastructure services and facilities in order to compensate for deficiencies in the publicly supplied infrastructure services (World Bank, 1994).

These developments mean that infrastructure cannot be viewed as an economic activity exclusively in the public domain. Results of studies of the effects of public investment on productivity (e.g. Aschauer, 1989) may not fully correlate with the effects of infrastructure on productivity to the extent that studies do not include the significant infrastructure investments in the private sector and the complex synergisms and complementarities between public and private infrastructure investments.

A second important bias in thinking about infrastructure, stems from the belief that the impacts of infrastructure investment on an economy are best understood by looking at the macroeconomy. This view, in turn, may be widely held because of the tendency to think of infrastructure investment as public investment. When analyzing the role of public investment in an economy, a macroeconomic approach is the traditionally dominant perspective and this has carried over to analyses of infrastructure as well.

The macroeconomy bias masks several crucial aspects of the complex process by which infrastructure affects an economy. For example, urban economies play an increasingly important

role in the growth of most developing economies. Most industrialization occurs in urban areas and, in the developing countries, the urban areas house increasing proportions of national populations and gross national product. Because of these trends, infrastructure investments are becoming increasingly concentrated in urban areas and urban growth is becoming strongly correlated with national growth.

It is increasingly recognized in recent years that urban concentrations of economic activity contribute significantly to economic growth (World Bank, 1991). Because urban economic activity depends heavily on infrastructure investments such as roads, power supply and water, the effects of infrastructure on the national economy can be understood better by studying first how the productivity of an urban economy responds to infrastructure services and then how increased productivity in urban areas shapes macroeconomic growth.

More importantly, the economic effects of infrastructure investments can be evaluated and analyzed better by taking an explicitly microeconomic approach. The key to such an effort is the study of the processes by which infrastructure influences households and businesses, the individual agents which drive the economy. A proper microeconomic approach would recognize that economic agents are not mere users of infrastructure services supplied by the public sector but can also act as producers of some of these infrastructure services.

Production of infrastructure services by households and businesses competes with public infrastructure provision. When deficiencies in the public infrastructure supplies or in the delivery of services are significant so as to retard the productivity of individual agents, the private sector will step in and, at least partially, fill that gap. This will happen even when privately provided infrastructure is handicapped by higher costs. The private sector will bear such higher costs if

the privately provided infrastructure is superior in quality to the public infrastructure.

Participation of the private sector in infrastructure provision can take one of two forms. Individual agents may respond by partially or completely producing their own infrastructure needs. Examples are households and firms installing power generators to circumvent blackouts in public electricity supplies and businesses hiring messengers to bypass unreliable telephone service [Lee and Anas, 1992a]. The second response pattern is the emergence of privately controlled infrastructure industries which produce and deliver services to households and businesses. Examples of this are water vendors who may supply the daily water needs of villages not served well by public water delivery [Whittington et.al. 1989] and package and message delivery firms that compensate for the lack of adequate public mail and telephone services and privately owned and operated utility companies.

A PUBLIC POLICY FRAMEWORK

The perspective that infrastructure should be studied using microeconomics and the observation that infrastructure issues straddle the public and the private sectors, means that public policy towards infrastructure needs to be rethought.

There are several policy implications which stem from this new perspective.

First, proper accounting of the infrastructure stock of a nation must consider the infrastructure facilities and services provided in the private sector as well as the infrastructure provided by the public sector, either in-house by households and businesses or through the infrastructure service markets.

Second, public policy on infrastructure must be formulated by taking into account how

the private sector will respond to each policy by modifying its stock and configuration of infrastructure capacities so that the benefits from all infrastructure (public as well as private) are maximized. More specifically, it is a challenge to policy makers that policies on infrastructure do not result in wasteful duplication of infrastructure facilities or in ruinous competition between public and private infrastructure providers. Rather, policy makers should seek to formulate policies on infrastructure which seek to enhance the complementarities and synergisms between the publicly and privately provided infrastructure services.

Third, a microeconomic perspective should be adopted in seeking and formulating innovative policies toward infrastructure. In such an effort insights from the theory of industrial organization are the most relevant and aggregative studies of the impacts of infrastructure on the macroeconomy are the least relevant. Policy makers must learn to work with the private infrastructure markets, developing policies which induce and encourage the private infrastructure markets to step in and fill the infrastructure gaps in those areas where the public infrastructure services are inadequate and difficult to improve.

Fourth, in many developing countries, there is a complex web of regulations and institutional barriers which inhibit the private provision of infrastructure services. Such constraints and barriers need to be relaxed for the private sector to achieve its potential in filling infrastructure gaps. Although in some parts of the developing world, governments are beginning to welcome such private participation, it is still true in the rest of the world that infrastructure services are provided by protected public monopolies even in the face of highly inefficient behavior by such monopolies.

Fifth and finally, infrastructure policy entails important efficiency-related and

distributional questions. The distributional aspects of infrastructure policy tend to get masked in the macroeconomic approach to viewing infrastructure. However, once a microeconomic approach is adopted, it becomes clear that not all agents in an economy have equal access to infrastructure services and facilities and that not all micro agents can compensate with equal ease and cost for the deficiencies in public infrastructure systems. In particular, because many types of infrastructure require significant scale economies, smaller users of infrastructure such as households and small businesses bear a disproportionate burden of private provision. For this reason, it is especially important that public policy seek to foster the emergence of viable infrastructure service providers in the markets.

PROJECT RATIONALE, GOALS, AND METHODS

The purpose of this research project and the earlier project on Nigeria was to make specific contributions to the study of infrastructure in a way which is consistent with the above perspective.

A chief substantive goal in the project was to study infrastructure provision in the private sector and how such provision related to the quality of the infrastructure services provided by the public sector.

A second and equally important methodological goal was to analyze the infrastructure-related questions at the microeconomic level and, in this way, lay the foundation for a "bottom-to-top" approach to the infrastructure question. The microeconomic perspective meant that the units of analysis had to be individual economic agents not industries or other economic aggregates.

Practical considerations restricted the scope of the study in a number of ways.

First, we focused on the infrastructure related problems and investments of manufacturers only. Thus, the way in which infrastructure deficiencies directly impacted households, public agencies and non-manufacturing businesses was not studied.

Second, relatively little data on infrastructure needs and conditions were available for individual manufacturers in an economy. For this reason, virtually all of the needed micro level data had to be collected within the project by means of questionnaires directed to a sample of manufacturers in each country. The questionnaires used in each country are contained in the Annex to the project reports.

Third, because project resources were limited, we could not devote equal attention to each of the important infrastructure sectors on which we collected data. Although data was collected on manufacturers' infrastructure needs and conditions with respect to power provision, water supply, labor and freight transport, telecommunications and waste disposal, the quantity and quality of information obtained varied considerably among these sectors. Hence, the project's chief contribution has been on an extensive and detailed analysis of infrastructure deficiencies and manufacturers' responses in power generation, a more limited analysis of the water supply deficiencies and responses and merely descriptive presentations of the problems and private responses in transport, telecommunications and waste disposal. Despite this selective focus, we believe that our findings and conclusions do generalize to virtually all infrastructure sectors and we have gathered much evidence through field observations to support the belief.

In studying manufacturers' responses to deficiencies in the power sector we had several specific project objectives.

First, we sought to study the three countries (Nigeria, Indonesia and Thailand) using a unified framework of analyses, models and concepts. This provides a useful test of our microeconomic approach in different national environments and, hence, a demonstration of the transferability of the approach. The use of the three countries, also allows us to make comparisons of how manufacturers' needs and responses vary as the level of public infrastructure deficiencies vary from very bad in Nigeria, to serious in Indonesia, to much better in Thailand.

Second, we aimed to develop a microeconomic theory of the firm (i.e. the representative manufacturer in our samples) which allows the firm to blend electricity it purchases from the public sector with electricity which it produces internally. Such a model in which electricity production is a technology embedded within the firm's primary production technology allows us to examine, in detail, the substitution and complementarity relationships between electricity and other inputs in primary production and, more importantly, between public sector and internally generated electricity.

Third, we aimed that our microeconomic model be amenable to econometric estimation so that various measures of the firms' production technology can be quantified and analyzed in order to shed light on the central policy questions in each country and in order to facilitate comparisons across the three different countries.

Our theoretical model and its associated econometric procedure can be applied to the other infrastructure sectors and we have in fact tested it to a limited extent for the water sector in Nigeria where internal provision of water by firms (which sink boreholes on their factory lots) competes with water supply from the public sector. With better data in the future, when the microeconomic approach to infrastructure becomes more widely accepted, we believe that our

model can be applied to a joint analysis of all the infrastructure responses of firms. With appropriate modification, the model can also be applied to the behavior of households and non-manufacturing businesses.

As a fourth objective, we used our estimated microeconomic model to shed light on a number of policy issues regarding the pricing of publicly supplied electricity. Although we recognize that pricing is a small part of the big policy picture, it is nevertheless an important piece of it. While pricing policy should not be contemplated as separate from the broader issues of industrial organization, there is no possible industrial reorganization of infrastructure which does not carry with it strong implications for an appropriate pricing policy.

As a fifth and final objective, we have placed our findings regarding the pricing of public infrastructure services, into the broader context of industrial organization policy [Baumol and Lee, 1991]. In particular, the theory of contestable markets is the appropriate theoretical backdrop against which the organization of private and public infrastructure markets, including questions of pricing, should be considered.

The support for our recommendations for policy actions in the industrial organization front are supported by extensive evidence we have gathered in field observations, by case studies of deregulation of utilities in developing countries and by some of the qualitative and quantitative responses of the firms in our samples of manufacturers in the three countries.

EMPIRICAL FINDINGS

Our empirical findings are grouped into three parts : those which are supported by the descriptive analysis of the data in the three surveys as well as our field observations [Report No. .

1], those which are revealed by the econometric testing of our microeconomic model [Report No.2] and those which flow from policy simulations on pricing based on the results of the econometric analysis [Report No.3].

The descriptive results are detailed in Report Number 1 [Project Background and Descriptive Analysis] as well as in prior discussion papers [Lee and Anas, 1989 and 1992b]. The findings from the descriptive analysis enriched our qualitative and quantitative understanding of the impact of infrastructure deficiencies on manufacturing establishments.

Not surprisingly, we were able to document that firms can adjust to infrastructure deficiencies in a number of ways. An obvious form of adjustment is that a business remains captive to the inadequate public service incurring the higher costs associated with the unreliability of such service. This results in lower productivity, less output and lower quality output. The infrastructure deficiency can affect the firm's production process in a multitude of ways which depend on the technology used by the firm.

Some firms are so sensitive to fluctuations in power or other infrastructure that, when they are in the "captive" regime, any interruption in supply forces them to shut down or suffer prohibitive losses to output or to inputs (e.g. machinery). Other firms are not impacted as severely but they suffer by losing output or producing lower quality output. A second type of response occurs when the firm is resourceful enough that it tries to achieve self-sufficiency by producing its entire infrastructure need within the plant. This, of course, is typical of the larger firms but is observed for some smaller firms as well. A self-sufficient firm usually incurs a much higher unit cost because it cannot match the scale economies which are available to the public sector.

A third and more interesting response entails a compromise between captivity and self-sufficiency. In the case of electric power, for example, the firm blends the two types of power : the public power source which is cheap but of lower quality (e.g. subject to more voltage fluctuations) and the firm's own power source which is more expensive but of a higher quality. We found that firms blend for a variety of reasons which relate to their technology of production and to their attitudes towards risk and uncertainty.

One reason for blending, as we have already hinted above, is that captivity and self-sufficiency are each prohibitively expensive. By blending, the firm allows itself use of the public supply in those periods during its production runs when such supply is relatively reliable and switches to its own power when it detects that the public supply begins to or is likely to fail or deteriorate in quality. Such a firm might install sophisticated equipment for detecting upcoming voltage fluctuations. This behavior is typical of firms that must have a reliable or uninterrupted power supply at all times.

A second reason for blending is that the higher quality internal power supply is used at all times in order to "boost" the lower quality public supply, thus assuring the firm a continuous supply of reliable power.

Blending and self-sufficiency are achieved by installing private generating capacity within the plant. We observed that in Nigeria (more than in the other countries) virtually all firms had installed a generating capacity which was sufficient to power the entire plant if necessary. Hence, such firms were observed to be carrying idle generating capacity at almost all times. This is an indication that private generating capacity is seen, in part, as insurance against prolonged shutdowns in the public sector. It was not surprising that such idle generating capacity should

be highest in Nigeria where interruptions in the public supply are severe and frequent, less common in Indonesia where interruptions are less frequent and external alternatives to the public source are available, and even less common in Thailand where the public supply of power is more reliable.

The effects of deficiencies on business formation and on employment growth are difficult to observe directly but easy to surmise. On the margin, infrastructure deficiencies and the high fixed costs of offsetting such deficiencies should retard business formation and employment growth. The extent of this effect is a worthwhile topic for further study but requires more sophisticated data collection.

An increase in infrastructural deficiencies can also cause some existing firms to go out of business or to cancel or delay plans for expansion. It is obvious that the retarding effects on potential new firms and marginal existing firms increase in severity as firm size gets smaller because smaller firms do not have the scale economies for dealing with the high setup costs of internal infrastructure provision.

Households, as well as firms, must choose how to adapt to infrastructure inadequacies. Like firms, households can choose among remaining captive to inadequate public service, opting for self-sufficiency, and blending public and own provision. For example, in the case of electricity, most households opt for captive status, and few for self-sufficiency, while in Nigeria, some wealthy households opt for blending, buying power generators for use when the public service fails.

Using the quantitative responses of the surveyed manufacturers in Nigeria, Indonesia and Thailand we were able to document clearly how the burden of private infrastructure provision

decreases with the size of firm. This was found to be true in each country and for each type of infrastructure : power, water, transport, telecommunications and waste disposal. As extensively documented in Report Number 1, smaller manufacturers on the average devote a higher percentage of their resources to each one of these infrastructural needs and pay higher implicit marginal prices in self provision than do larger firms. In the case of power provision in Nigeria, small manufacturers bear marginal costs as much as seven or eight times higher than the marginal costs born by the public sector. These high multiples are evidence that firms attach great value to a high quality power supply.

An econometric confirmation of the basic result that the marginal cost of embedded electricity substantially declines with firm size, was done using our econometric models of the blending firms in Nigeria and Indonesia. (There were very few blenders in Thailand where the public power supply is fairly reliable). The econometric results are included in Report Number 2 [Econometric Analysis].

In addition to confirming the presence of strong scale economies in private provision, our econometric results for Nigeria and Indonesia revealed that the shadow prices of firms for the publicly supplied electricity were much higher than the marginal costs of purchasing such electricity and also much higher than the marginal cost of producing electricity internally. As well, the marginal cost of producing electricity internally, as noted earlier, was generally higher than the marginal tariff price paid to the public sector for purchased electricity.

Since shadow price measures the willingness to pay for marginal quantities of a limited resource, the finding that the shadow price for public electricity exceeds the marginal cost of internally produced electricity means that firms would much prefer to buy their electricity rather

than to produce it themselves.

If own electricity and purchased electricity were perfect substitutes in production, firms should value additional purchased electricity at the marginal cost of the produced electricity they decided to produce. The fact that this was not found strongly suggests that internally produced and purchased electricity are complements not substitutes.

A robust econometric finding was that the shadow price of bought electricity fell with the level of electricity bought. Larger firms (which buy more electricity) value bought electricity less at the margin than do smaller firms. The elasticity of the shadow price with respect to bought electricity (a proxy for the size of the firm) in each country was highly similar to the elasticity of the marginal cost of internal electricity with respect to the quantity of internal electricity. These similarities suggest that the firms' willingness to pay for public electricity varies directly with the firms' marginal cost of providing their own electricity.

As we shall see below, these empirical findings serve as the underpinnings of our policy recommendations for a more efficient and equitable infrastructure policy in developing countries.

POLICY RECOMMENDATIONS: MARKETS FOR INFRASTRUCTURE SERVICES

The starting point for the need to reform infrastructure policy in developing countries is that publicly supplied infrastructure services are limited in both quality and quantity. The reasons for such limitations vary among countries.

In Nigeria, where economic growth has not been rapid in recent decades, the infrastructure limitations arise from inefficiencies in management, in the supply and delivery of spare parts and in maintenance. In the Nigerian power sector there is an adequate generating

capacity all of which is controlled by NEPA (the Nigerian Electric Power Authority) but the above causes of inefficiency result in bottlenecks in the transmission and distribution of electricity. For a variety of reasons (stemming from X-inefficiencies of all kinds), the sources of the inefficiencies cannot be eliminated in the short run and it is realistic to assume that the problems will persist for the long run.

In Indonesia, and more so in Thailand, the same difficulties do not appear to exist but the rapid growth of these two economies makes it difficult for the public sector to expand its generation, transmission and distribution of power at an adequate pace. This, in turn, has resulted in bottlenecks which reduce the supply of reliable power and other infrastructure services supplied by the public sector.

What is an appropriate industrial organization policy in light of such a limitation on the part of the public sector to eliminate or substantially reduce infrastructure deficiencies ?

Our most fundamental argument is that a policy of protecting the public infrastructure monopolies is not optimal. Such a protectionist approach prevents the users of infrastructure services from seeking other sources of infrastructure services and induces them to succumb to the regime of captivity which, as we discussed, retards productivity.

A protectionist policy towards NEPA is observed in Nigeria. The government supports NEPA as the single supplier of power in the whole country, does not allow private utility companies to enter the power market and taxes imported electricity generators that are installed by manufacturers. Although manufacturers are allowed to install their own generating equipment they must obtain a government license to do so and this can be an expensive and time consuming process. Manufacturers are not allowed to sell power to each other. In Indonesia, on the other

hand, the PLN is a public monopoly which receives less government protection. The government has reduced import taxes on generators and is beginning to allow the formation of private power generating utilities.

Clearly, the Indonesian policy towards private sector participation is more efficient socially than is the Nigerian policy of extreme protectionism. A further inefficiency occurred in Nigeria where the government policy prior to 1989 sought to offset the poor quality of publicly available power by greatly subsidizing NEPA so that public power was priced much below its marginal cost of production. This situation was partially remedied by the sizable increase in the electricity tariff in 1989. However, as we shall see in the next section, the structure of the Nigerian tariff needs considerable overhauling before it can become fully efficient. In Indonesia, power pricing is more sensible and PLN recovers all of its operating cost plus a portion of the cost of new investment.

The big gains in economic efficiency in developing countries would come from a reorganization of the infrastructure sectors. The relevant theory for guiding such a reorganization policy is the theory of contestable markets. In the case of Nigeria we were able to illustrate how this would work in the power sector. The theory of contestable markets is based on the notion that complex and interrelated economic activities can be unbundled into separate but related functions. Those functions which are subject to high scale economies and are associated with high sunk costs are candidates for remaining in the public sector or operated by large monopolies regulated by the government. In the market for power, the transmission and distribution network is such an activity. It would be natural for NEPA to remain the single operator of the national transmission and distribution grid.

Power generation, on the other hand, is characterized by relatively low entry costs and is a contestable industry. Were Nigerian policy to allow it, a number of market arrangements would emerge. Many large firms would find it feasible to utilize their idle excess generating capacity by producing electricity and selling it to adjacent smaller firms or to NEPA's grid. Private power companies would emerge and would make use of NEPA's grid by transmitting their power to various customers. Utility pools would potentially emerge as consortia of closely located firms that would build their own common power plant which would sell its excess power to NEPA's grid.

The options available to the small manufacturers would increase, as such firms would be able to buy power from NEPA, from larger firms in their vicinity, from private power companies or from utility pools. NEPA's revenues would be enhanced by selling use of its grid to the various private suppliers. In the long run, if NEPA could improve grid operations and reduce transmission bottlenecks, an increasing portion of the privately produced power would be transacted on the transmission grid. In the short run, the private producers would prefer, where possible, to sell their power off the grid in order to avoid the transmission problems.

To move in this direction of making the market for power as fully contestable as possible, Nigerian authorities would have to liberalize the production, buying and selling of power among the various users of power. Indonesia and Thailand are moving in this direction while Nigeria shows no signs of reforming its practice.

The contestability of various infrastructure services means that many users of public infrastructure services would find attractive substitutes in the private sector. This in turn means that the demand for the public services which are limited in quantity and quality would decrease.

Hence, with reduced demands, bottlenecks in the delivery of public infrastructure services would become reduced as well. This, in turn, would improve the quality of services available through the public sector.

Liberalized and contestable infrastructure provision is one way of dealing with the more efficient allocation of the scarce infrastructure capacity of a developing nation. These policies would make infrastructure services more readily available to the smaller users who find it most difficult to absorb the high cost of infrastructure deficiencies.

POLICY RECOMMENDATIONS: PUBLIC INFRASTRUCTURE PRICING

How the public sector prices its infrastructure services is an integral component of a better infrastructure policy. First, the public sector or some regulated monopolistic supplier will continue to remain the chief supplier of infrastructure services such as power and water. It is reasonable to assume that the majority of users will continue to purchase services from such a large supplier. Second, it is also reasonable to assume that the causes of the infrastructure deficiencies will continue to persist and bottlenecks in transmission of power or in the delivery of water will remain as long run conditions.

Under such circumstances, how can pricing scarce infrastructure resources result in a better allocation of these resources ? We can begin to answer this by looking at current infrastructure pricing policy in developing countries. We see that in the three countries we studied, the public providers charge a tariff with quantity discounts (decreasing block tariff) much as one would find in the developed and industrialized countries. The usual rationale behind decreasing block tariffs is that they encourage the purchase of larger quantities thus enhancing

the economies of scale inherent in production and in delivery.

The situation is quite different when infrastructure deficiencies are present as is the case in developing countries. When such is the case, the production of larger quantities puts a strain on the delivery of the service by increasing system load and system congestion. This, in turn, results in bottlenecks and in failures which reduces the quality of the infrastructure service delivered.

Recall now our finding, explained earlier, that the smaller users of infrastructure services value such services more (have higher shadow prices) than do the larger users. Yet the smaller users also have a lower capacity to bear the costs of private provision because their operations do not have the benefit of high scale economies. Hence, decreasing block tariffs in a developing countries context favor the larger users who value the infrastructure service the least and burden the smaller users who value the service the most.

To rectify this situation by making the limited infrastructure services available to those who value it the most, we recommend that public sector power in Nigeria and Indonesia be sold according to an increasing block tariff. Under such a tariff, the marginal price charged to a larger purchaser of electricity will be much higher than the marginal price charged to a small purchaser.

In the case of manufacturers, the larger firms which have sufficient generating capacity installed will prefer to produce more of their own power from their own generators, reducing their reliance on the public source. The smaller users, will be facing much lower prices from the public sector and may decide to stop using their generators and rely more heavily on the public source. The result, so far, is that power will have been allocated from those who value

it the least and face the lowest cost in producing it privately to those who value it the most and face the highest marginal cost in producing it privately. Such a redistribution increases social efficiency.

A further benefit exists if the reallocation of power induced by an increasing block tariff is such that the aggregate purchases of power from the public sector are reduced. When that happens, then the level of congestion on the public transmission network is lowered and the quality of the power delivered increases. The increasing block tariff results not only in a socially more efficient redistribution of the infrastructure service but in a higher quality service as well.

In Report Number 3 we describe the results of various simulations in which NEPA and PLN are assumed to switch their tariffs from a decreasing block structure currently present, to an increasing block structure that maximizes the welfare gain from the switch. In Nigeria, which currently offers steep quantity discounts, savings in total manufacturing operating costs were about 4 % assuming there were no changes in public power reliability. Allowing for the possibility that reliability improved as the demand for public power fell, the total cost savings increased to 7.3 % or 9 % depending on the elasticity of reliability with respect to aggregate purchase from the public sector.

The results for Indonesia are much less dramatic, because the decreasing block nature of PLN's tariff is very slight and because under the more liberal Indonesian policies a big part of the potential benefits have already been realized. Cost reductions from an optimal tariff without a change in reliability was only 0.1 %. Even under the assumption that unreliability fell as purchases decreased, percentage cost savings were still minimal.

In both Nigeria and Indonesia, the benefits in the form of savings in operating costs were

the highest for the smaller manufacturers. The optimal tariff was one with a steep increasing block structure. Such a tariff is well approximated with a rationing policy that disconnects from NEPA or PLN those large manufacturers who have adequate private generating capacity installed and sells power to the smaller users for a very low marginal price. The marginal price remains low with the quantity purchased up to a point and then rises steeply with quantity purchased. The policy makes better use of the generating capacity installed in the private sector.

While Nigeria stands to reap big gains from implementing an increasing block tariff policy, the same policy will have only slight benefits in Indonesia, where public policy has been moving gradually away from a protectionist stance and where the existing tariff structure does not incorporate significant quantity discounts.

CONCLUSIONS

The chief contributions of this study has been to demonstrate the strong complementarity between the public and private infrastructure sectors in developing nations. Cases in point are the manufacturing sectors of Nigeria, Indonesia and Thailand where significant adjustments in the private sectors have mitigated infrastructural deficiencies with various degrees of success.

Government policy towards the industrial organization and pricing of infrastructure sectors plays an important role in helping an economy realize the benefits of private sector participation and in mitigating the adverse effects of infrastructure deficiencies on small manufacturers. Our policy recommendations apply with full force in Nigeria where the government continues to be protective of public infrastructure monopolies and not friendly to private sector participation. Our recommendations are supported by the relative successes of

Indonesia and Thailand where the impacts of the deficiencies have been rendered less severe, in part, because the public sector has encouraged private sector involvement in infrastructure provision.

REFERENCES

- Aschauer, David, 1989. Is Public Expenditure Productive ?, Federal Reserve Bank of Chicago, Staff Memorandum.
- Baumol, William and Kyu Sik Lee, 1991. "Contestable Markets, Trade and Development", The World Bank Research Observer, vol.6, no.1, 1-17.
- Lee, Kyu Sik and Alex Anas, 1989. "Manufacturers' Responses to Infrastructure Deficiencies in Nigeria : Private Alternatives and Policy Options", Discussion paper, INU 50, Infrastructure and Urban Development Department, The World Bank, Washington, D.C., July.
- Lee, Kyu Sik and Alex Anas, 1992a. "Costs of Deficient Infrastructure : The Case of Nigerian Manufacturing", Urban Studies, vol.29, No.7, 1071-1092.
- Lee, Kyu Sik and Alex Anas, 1992b. "Impacts of infrastructure Deficiencies on Nigerian Manufacturing : Private Alternatives and Policy Options", Discussion Paper, INU 98, Infrastructure and Urban Development Department, The World Bank, Washington, D.C., February.
- Whittington, D., D.T. Lauria and X. Mu, 1989. "Paying for Urban Services : A Study of Water Vending and Willingness to Pay for Water in Onitsha, Nigeria", Infrastructure and Urban Development Department, Report INU 40, The World Bank, Washington, D.C.
- The World Bank, 1991. Urban Policy and Economic Development : An Agenda for the 1990s, Washington, D.C.
- The World Bank, 1994. World Development Report 1994: Infrastructure for Development, Washington, D.C.

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